

WHAT IS CLAIMED IS:

- 1                   1.       A tissue stabilizer for endoscopically stabilizing a target tissue  
2       within a patient's body, the tissue stabilizer comprising:  
3                               a shaft sized to allow insertion through an endoscopic cannula; and  
4                               a manipulable foot connected with the shaft, wherein the foot  
5       comprises a first toe portion and a second toe portion, the first and second toe portions  
6       being rotatably coupled with the shaft, each toe portion comprising at least one suction  
7       port to apply suction to the target tissue during stabilization, the first toe portion and  
8       second toe portion rotateable to a first arrangement wherein the foot is insertable through  
9       the endoscopic cannula.
- 1                   2.       A tissue stabilizer as in claim 1, wherein the first and second toe  
2       portions are rotatably coupled to the shaft by a split ball joint assembly, the split ball joint  
3       assembly allowing the first and second toe portions to rotate with respect to the shaft and  
4       with respect to each other.
- 1                   3.       A tissue stabilizer as in claim 2, wherein each toe portion  
2       comprises a ring mount.
- 1                   4.       A tissue stabilizer as in claim 3, wherein the split ball joint  
2       assembly further comprises a top ball shell and a bottom ball shell which together encase  
3       the ring mounts of the first and second toe portions to form a spherical split ball shell.
- 1                   5.       A tissue stabilizer as in claim 4, wherein the toe assembly further  
2       comprises a torsion spring to rotate the first toe portion and second toe portion to a second  
3       arrangement wherein the first toe portion and second toe portion are at least 8 mm apart.
- 1                   6.       A tissue stabilizer as in claim 1, wherein the foot further comprises  
2       an adjustable ankle coupling the first toe portion and the second toe portion to the shaft..
- 1                   7.       A tissue stabilizer as in claim 6, wherein the foot is moveable in six  
2       degrees of freedom relative to the shaft by adjusting the ankle.
- 1                   8.       A tissue stabilizer as in claim 6, wherein the ankle comprises an  
2       adjustable neck comprising a series of interlocking balls and intermediate socket rings.

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1                   9.       A tissue stabilizer as in claim 8, wherein each ball is independently  
2 rotateable against an adjacent ring to allow the neck to be adjusted.

1                   10.       A tissue stabilizer as in claim 6, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball assembly, and  
3 wherein the ankle comprises a housing within which the spherical split ball assembly is  
4 disposed.

1                   11.       A tissue stabilizer as in claim 10, wherein the spherical split ball  
2 assembly is rotateable within the housing to adjust the position of the foot in relation to  
3 the shaft.

1                   12.       A tissue stabilizer as in claim 1, further comprising at least one  
2 suction tube connectable with the at least one suction port.

1                   13.       A tissue stabilizer as in claim 12, wherein the shaft comprises a  
2 suction lumen and the suction tube is insertable through the suction lumen.

1                   14.       A tissue stabilizer as in claim 13, wherein the suction tube  
2 comprises a suction tip which is connectable with the at least one suction port by insertion  
3 into a suction tube receptacle.

1                   15.       A tissue stabilizer as in claim 1, further comprising an irrigator.

1                   16.       A tissue stabilizer as in claim 15, wherein the shaft comprises an  
2 irrigation lumen and the irrigator is insertable through the irrigation lumen.

1                   17.       A tissue stabilizer for endoscopically stabilizing a target tissue  
2 within a patient's body, the tissue stabilizer comprising:

3                   a shaft having a proximal end and a distal end, the shaft sized to allow  
4 insertion through an endoscopic cannula;

5                   an adjustable ankle connected with the distal end of the shaft;

6                   a manipulable foot connected with the ankle, wherein the foot comprises a  
7 first toe portion rotateably joined with a second toe portion, each toe portion comprising  
8 at least one suction port to apply suction to the target tissue during stabilization, the first

9 toe portion and second toe portion rotateable to a first arrangement wherein the foot is  
10 insertable through the endoscopic cannula; and  
11 a tension cable passing through the shaft wherein applying tension to the  
12 cable locks the ankle in position.

1 18. A tissue stabilizer as in claim 17, wherein the ankle comprises an  
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings.

1 19. A tissue stabilizer as in claim 18, wherein each ball is  
2 independently rotateable against an adjacent ring to allow the neck to be adjusted.

1 20. A tissue stabilizer as in claim 18, wherein each ball and socket ring  
2 has a hollow core through which the tension cable extends.

1 21. A tissue stabilizer as in claim 20, wherein the balls and socket rings  
2 are arranged so that applying tension to the cable wedges the balls and socket rings  
3 together to lock the ankle in position by friction.

1 22. A tissue stabilizer as in claim 20, wherein the balls and socket rings  
2 are shaped so that applying tension to the cable causes at least one ball to apply a force to  
3 at least one socket ring at an angle of at least 60 degrees in relation to the cable.

1 23. A tissue stabilizer as in claim 17, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball shell, and wherein  
3 the ankle comprises a housing within which the spherical split ball shell is disposed.

1 24. A tissue stabilizer as in claim 23, wherein the spherical split ball  
2 shell is rotateable within the housing to adjust the position of the foot in relation to the  
3 shaft.

1 25. A tissue stabilizer as in claim 23, wherein by applying tension to  
2 the cable the spherical split ball shell is locked within the housing so that the position of  
3 the foot is fixed in relation to the shaft.

1 26. A tissue stabilizer as in claim 25, wherein the tension cable  
2 comprises a locking ball disposed within the housing and wherein applying tension to the  
3 cable moves the housing so that the spherical split ball shell is locked within the housing.

1                   27.     A tissue stabilizer as in claim 17, further comprising a handle  
2     connected with the proximal end of the shaft, wherein rotation of the handle applies  
3     tension to the tension cable.

1                   28.     A tissue stabilizer as in claim 27, wherein the handle comprises  
2     ratchet pawls which lock the cable under tension.

1                   29.     A tissue stabilizer as in claim 27, wherein the handle comprises a  
2     release button which unlocks the cable from tension.

1                   30.     A system for endoscopically stabilizing a target tissue within a  
2     patient's body, the system comprising:  
3                   an endoscopic cannula; and  
4                   a tissue stabilizer comprising  
5                         a shaft sized to allow insertion through the endoscopic cannula, and  
6                         a manipulable foot connected with the shaft, wherein the foot  
7     comprises a first toe portion rotateably joined with a second toe portion, each toe portion  
8     comprising at least one suction port to apply suction to the target tissue during  
9     stabilization, the first toe portion and second toe portion rotateable to a first arrangement  
10    wherein the foot is insertable through the endoscopic cannula.

1                   31.     A system as in claim 30, further comprising an adjustable ankle  
2     disposed between the foot and the shaft.

1                   32.     A system as in claim 31, wherein the ankle comprises an adjustable  
2     neck comprising a series of interlocking balls and intermediate socket rings.

1                   33.     A system as in claim 32, wherein each ball is independently  
2     rotateable against an adjacent ring to allow the neck to be adjusted.

1                   34.     A system as in claim 30, wherein the first toe portion is rotateably  
2     joined with the second toe portion by a spherical split ball shell, and wherein the ankle  
3     comprises a housing within which the spherical split ball shell is disposed.

1                   35.     A system as in claim 34, wherein the spherical split ball shell is  
2     rotateable within the housing to adjust the position of the foot in relation to the shaft.

1 36. A system as in claim 30, further comprising at least one suction  
2 tube connectable with the at least one suction port.

1 37. A system as in claim 36, wherein the shaft comprises a suction  
2 lumen and the suction tube is insertable through the suction lumen.

1 38. A system as in claim 36, wherein the suction tube comprises a  
2 suction tip which is connectable with the at least one suction port by insertion into a  
3 suction tube receptacle.

1 39. A system as in claim 30, further comprising an irrigator.

1 40. A system as in claim 39, wherein the shaft comprises an irrigation  
2 lumen and the irrigator is insertable through the irrigation lumen.

1 41. A system as in claim 39, wherein the irrigator comprises an  
2 adjustable dispenser terminating in a spout portion.

1 42. A system as in claim 41, wherein the dispenser comprises a  
2 plurality of beads coupled in a chain-like fashion.

1 43. A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:

3 inserting a tissue stabilizer through an endoscopic cannula wherein the  
4 tissue stabilizer comprises  
5 a shaft having a proximal end and a distal end, and  
6 a manipulable foot connected with the shaft wherein the foot  
7 comprises at least two toe portions, each toe portion comprising at least one suction port;  
8 positioning the manipulable foot against the target tissue; and  
9 applying suction to the target tissue through the at least one suction port to  
10 stabilize the target tissue.

1 44. The method as in claim 43, wherein the foot comprises a first toe  
2 portion rotateably joined with a second toe portion, said method further comprising  
3 rotating the first or second toe portions to a first arrangement wherein the foot is  
4 insertable through the endoscopic cannula.

1                   45.     The method as in claim 43, wherein the tissue stabilizer further  
2 comprises an adjustable ankle disposed between the foot and the shaft, said method  
3 further comprising adjusting the ankle to adjust the position of the foot in relation to the  
4 shaft.

1                   46.     The method as in claim 45, wherein the adjustable ankle comprises  
2 an adjustable neck comprising a series of interlocking balls and intermediate socket rings,  
3 said method further comprising rotating at least one ball against an adjacent ring

1                   47.     The method as in claim 45, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball shell and wherein  
3 the ankle comprises a housing within which the spherical split ball shell is disposed, said  
4 method further comprising rotating the spherical split ball shell within the housing to  
5 adjust the position of the foot in relation to the shaft.

1                   48.     The method as in claim 43, wherein the shaft has a suction lumen  
2 therethrough, said method further comprising inserting a suction tube through the suction  
3 lumen.

1                   49.     The method as in claim 48, wherein the suction tube has a suction  
2 tip, said method further comprising connecting the suction tip with the at least one suction  
3 port.

1                   50.     The method as in claim 43, wherein the shaft has an irrigation  
2 lumen therethrough, said method further comprising inserting an irrigator through the  
3 irrigation lumen.

1                   51.     The method as in claim 50, wherein the irrigator comprises an  
2 adjustable dispenser terminating in a spout portion, said method further comprising  
3 adjusting the dispenser so that the spout portion is directed at the target tissue.

1                   52.     The method as in claim 51, further comprising supplying a fluid to  
2 the irrigator so that the fluid exits the spout portion.

1                   53.     A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:

3 inserting a tissue stabilizer through an endoscopic cannula wherein the  
 4 tissue stabilizer comprises  
 5 a shaft having a proximal end and a distal end,  
 6 an adjustable ankle connected with the distal end of the shaft,  
 7 a manipulable foot connected with the shaft wherein the foot  
 8 comprises at least two toe portions, each toe portion comprising at least one suction port,  
 9 and  
 10 a tension cable passing through the shaft wherein applying tension  
 11 to the cable locks the ankle in position;  
 12 positioning the manipulable foot against the target tissue; and  
 13 applying suction to the target tissue through the at least one suction port to  
 14 stabilize the target tissue.

1 54. A method as in claim 53, further comprising applying tension to  
 2 the cable.

1 55. A method as in claim 54, wherein the ankle comprises an  
 2 adjustable neck comprising a series of interlocking balls and intermediate socket rings,  
 3 each ball and socket ring having a hollow core through which the tension cable extends,  
 4 and wherein applying tension to the cable wedges the balls and socket rings together to  
 5 lock the ankle in position by friction.

1 56. A method as in claim 54, wherein the foot comprises a first toe  
 2 portion rotateably joined with a second toe portion by a spherical split ball shell and  
 3 wherein the ankle comprises a housing within which the spherical split ball shell is  
 4 disposed, and wherein applying tension to the cable locks the spherical split ball shell  
 5 within the housing so that the position of the foot is fixed in relation to the shaft.

1 57. A method as in claim 56, wherein the tension cable comprises a  
 2 locking ball disposed within the housing and wherein applying tension to the cable moves  
 3 the housing so that the spherical split ball shell is locked within the housing.

1 58. A method as in claim 54, wherein the tissue stabilizer further  
 2 comprises a handle connected with the proximal end of the shaft, and wherein applying  
 3 tension to the cable includes rotating the handle.

1                   59.     A method as in claim 58, wherein the handle further comprises  
2 ratchet pawls, said method further comprising locking the cable under tension with the  
3 use of the ratchet pawls.

1                   60.     A method as in claim 59, wherein the handle further comprises a  
2 release button, said method further comprising depressing the release button to unlock the  
3 cable from tension.

1                   61.     A vessel occlusion device for controlling blood flow in a blood  
2 vessel, the device comprising:  
3                   a plate-like body having a bore intersecting a radial slot;  
4                   a flexible member having a free end and fixed end, wherein the fixed end  
5 is fixedly attached to the body and wherein the flexible member has a diameter sized so  
6 that the member is frictionally held in the radial slot upon insertion of the free end into  
7 the radial slot.

1                   62.     A device as in claim 61, wherein the flexible member comprises  
2 silicone tubing.

1                   63.     A device as in claim 61, wherein the plate-like body has a length of  
2 approximately 7.9 mm and a width of approximately 2.5 mm.

1                   64.     A device as in claim 63, wherein the plate-like body has a depth of  
2 approximately 1.3 mm.

1                   65.     A device as in claim 63, wherein the bore has a diameter of  
2 approximately 1.3 mm and a slot width of approximately 0.25 mm.

1                   66.     A device as in claim 65, wherein the flexible member has an outer  
2 diameter of approximately 0.05 inches.

1                   67.     A method of endoscopically preparing a blood vessel associated  
2 with a target tissue for a surgical procedure, said method comprising:  
3                   endoscopically positioning a tissue stabilizer at a first location against the  
4 target tissue to stabilize the tissue;



5                   endoscopically positioning at least one vessel occlusion device around the  
6 blood vessel to restrict blood flow therethrough;  
7                   removing the tissue stabilizer from the target tissue while the vessel  
8 occlusion device remains in place.

1                   68.     A method as in claim 67, further comprising repositioning the  
2 tissue stabilizer to a second location against the target tissue while the vessel occlusion  
3 device remains in place.

1                   69.     A method as in claim 67, wherein the tissue stabilizer comprises a  
2 shaft sized to allow insertion through an endoscopic cannula and a manipulable foot  
3 connected with the shaft, wherein the foot comprises a first toe portion rotateably joined  
4 with a second toe portion, the first toe portion and second toe portion rotateable to a first  
5 arrangement wherein the foot is insertable through the endoscopic cannula, and wherein  
6 endoscopically positioning the tissue stabilizer comprises positioning the foot against the  
7 target tissue.

1                   70.     A method as in claim 67, wherein the vessel occlusion device  
2 comprises a plate-like body having a bore intersecting a radial slot and a flexible member  
3 having a free end and fixed end, wherein the fixed end is fixedly attached to the body, and  
4 wherein endoscopically positioning at least one vessel occlusion device comprises  
5 passing the free end of the flexible member around the blood vessel and into the radial  
6 slot so that the member is frictionally held.

1                   71.     A method of controlling blood flow in a blood vessel, said method  
2 comprising:  
3                   providing a vessel occlusion device comprising  
4                             a plate-like body having a bore intersecting a radial slot, and  
5                             a flexible member having a free end and fixed end, wherein the  
6 fixed end is fixedly attached to the body;  
7                   passing the free end of the flexible member around the blood vessel and  
8 through the bore so that the blood vessel is encircled by the flexible member and the  
9 plate-like body;  
10                  pulling the flexible member so that the blood flow is restricted in the blood  
11 vessel; and

12 sliding the flexible member into the radial slot so that the member is  
13 frictionally held.

1 72. A method as in claim 71, further comprising sliding the flexible  
2 member out of the radial slot to release the flexible member so that blood flow through  
3 the blood vessel is increased.

1 73. A method as in claim 71, further comprising adjusting the position  
2 of the flexible member by sliding the flexible member out of the radial slot and re-sliding  
3 the flexible member into the radial slot.

1 74. A method as in claim 71, further comprising:  
2 providing a tissue stabilizer for endoscopically stabilizing a target tissue  
3 within or upon which the blood vessel is disposed; and  
4 positioning the tissue stabilizer against the target tissue to stabilize the  
5 tissue.

1 75. A tissue stabilizer for endoscopically stabilizing a target tissue  
2 within a patient's body, the tissue stabilizer comprising:  
3 a shaft sized to allow insertion through an endoscopic cannula; and  
4 a manipulable foot connected with the shaft, wherein the foot comprises a  
5 first toe portion and a second toe portion,  
6 the first and second toe portions being rotatably coupled with the shaft by  
7 a rotating joint assembly, the rotating joint assembly providing that at least one of the first  
8 and second toe portions are rotatable with respect to the shaft and providing that the first  
9 and second toe portions are rotatable with respect to each other,  
10 the first toe portion and second toe portion rotatable to at least a first toe  
11 arrangement wherein the foot is insertable through the endoscopic cannula.

1 76. A tissue stabilizer as in claim 75, wherein each toe portion  
2 comprises at least one suction port configured so as to apply suction to the target tissue  
3 during stabilization.

1 77. A tissue stabilizer as in claim 75, wherein the first toe arrangement  
2 is configured so that the first toe portion lies overlapping at least a portion of the second  
3 toe portion.

1                    78.     A tissue stabilizer as in claim 77, wherein the rotating joint  
2     assembly comprises a first a pivotal joint and a second pivotal joint, the first and second  
3     pivotal joints being coupled to the first and second toe portions respectively.

1            79.      A tissue stabilizer as in claim 77, wherein the rotating joint  
2      assembly comprises a split ball joint assembly.

1                    80.        A tissue stabilizer as in claim 79, wherein the split ball joint  
2        assembly further comprises a first split ball portion coupled to the first toe portion, and a  
3        second split ball portion coupled to the first toe portion, the first and second split ball  
4        portions being disposed adjacent one another so as to define at least a portion of a  
5        generally spherical ball assembly.

1                    81.      A tissue stabilizer as in claim 80, wherein each toe portion  
2      comprises a ring mount.

1                    82.        A tissue stabilizer as in claim 81, wherein the first split ball portion  
2        is disposed adjacent the ring mount of the first toe, and the second split ball portion is  
3        disposed adjacent the ring mount of the second toe, the first and second split ball portions  
4        together encase the ring mounts of the first and second toe portions.

1            83.     A tissue stabilizer as in claim 75, further comprising an adjustable  
2     ankle disposed between the foot and the shaft and coupling the foot to the shaft.

1            84.     A tissue stabilizer as in claim 75, further comprising an irrigator.

1            85.     A tissue stabilizer as in claim 75, further comprising at least one  
2     suction tube connectable with the at least one suction port.

1                    86.        A tissue stabilizer as in claim 75, further comprising a tension  
2 cable passing through the shaft wherein applying tension to the cable locks the foot in  
3 position with respect to the shaft and locks the toe portions in position with respect to one  
4 another.

1                    87.        A tissue stabilizer as in claim 75, further comprising at least one  
2        cleat device mounted to a portion of the foot, the cleat device being configured to  
3        releasable hold a flexible elongate member for vessel occlusion.

1                   88.     A joint assembly for adjustably supporting a portion of an  
2     endoscopic surgical instrument, comprising:  
3                   at least one ball member having a generally axially symmetrical convex  
4     external surface portion;  
5                   at least one socket member having a generally axially symmetrical  
6     concave internal surface portion; and  
7                   the ball member mating with the socket member by contact of the convex  
8     surface portion with the concave surface portion.

1                   89.     The joint assembly of claim 88, wherein the convex surface portion  
2     of the ball member has a curvature in the axial direction which is substantially greater  
3     than the curvature in the axial direction of the concave surface portion of the socket  
4     member, the contact between the convex portion and the concave portion defining a zone  
5     of contact spaced radially outward from the axis of the socket portion.

1                   90.     The joint assembly of claim 89, wherein the convex surface portion  
2     of the ball member has a generally spherical contour, and the concave surface portion of  
3     the socket member having a generally conical contour.

1                   91.     The joint assembly of claim 90, wherein each of the ball member  
2     and the socket member have a core lumen, the core lumen of the ball member being in  
3     communication with the core lumen of the socket member, the zone of contact being  
4     spaced substantially radially outward from the core lumen of the ball member.

1                   92.     The joint assembly of claim 91, further comprising a compression  
2     mechanism configured to selectably urge the ball member against the socket member, so  
3     as to produce a selectable frictional engagement of the ball member with the socket  
4     member to provide resistance to rotation of the ball member with respect to the socket  
5     member.

1                   93.     The joint assembly of claim 92, wherein the compression  
2     mechanism includes a flexible tension member passing through each of the core lumens,  
3     the tension element coupling at a first end to the ball member and at a second end to the  
4     socket member, the compression mechanism providing for selectably retracting the  
5     tension member so as to urge the ball member against the socket member.

1                   94.     The joint assembly of claim 89, wherein the joint assembly  
2 comprises a plurality of interconnected joint members, each joint member including one  
3 of said at least one ball members and one of said at least one socket members, the  
4 plurality of joint members being arranged in chain like fashion by the engagement of ball  
5 members with adjacent socket members.

1                   95.     A irrigator assembly for an for an endoscopic surgical instrument  
2 for supplying or removing fluids from a surgical site, comprising  
3                   an adjustable dispenser member including a plurality of interlocking beads  
4 coupled in a chain-like fashion;  
5                   the beads each having a core lumen communicating with the core lumen of  
6 each adjacent bead, so as to define a conduit for the passage of fluid.

1                   96.     The irrigator assembly of claim 95, wherein  
2 at least one bead includes a socket portion and a ball portion;  
3 the ball portion engaging a corresponding socket portion of a first adjacent  
4 bead; and  
5                   the socket portion engaging a ball portion of an second adjacent bead.

1                   97.     The irrigator assembly of claim 96, wherein the engagement of  
2 each ball portion with each socket portion is configured to produce a substantial non-  
3 locking frictional interaction, so as to resist rotation of the at least one bead with respect  
4 to adjacent beads, to provide for the stable adjustment of the dispenser configuration.

1                   98.     The irrigator assembly of claim 97, wherein the dispenser member  
2 terminates in a spout member in communication with the core lumens, the irrigator being  
3 connectable to a fluid supply for causing the flow of a fluid through the core lumens and  
4 the spout member to the surgical site.

1                   99.     The irrigator assembly of claim 98, wherein the dispenser member  
2 terminates in a intake member in communication with the core lumens, the irrigator being  
3 connectable to a suction source for causing the flow of a fluid through the core lumens  
4 and the intake member away from the surgical site.

1                   100. A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:  
3                   inserting a tissue stabilizer through an endoscopic cannula wherein the  
4 tissue stabilizer comprises  
5                   a shaft having a proximal end and a distal end, and  
6                   a manipulable foot connected with the shaft wherein the foot  
7 comprises at least two toe portions; and  
8                   positioning the tissue stabilizer with the use of a robotically operated  
9 surgical instrument from within the patient's body.

1                   101. A method as in claim 100, wherein positioning the tissue stabilizer  
2 comprises positioning the manipulable foot against the target tissue.

1                   102. A method as in claim 101, wherein positioning the manipulable  
2 foot comprises grasping at least one of the toe portions with the robotically operated  
3 surgical instrument.

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